L-Band Sea Surface Salinity in the Polar Oceans: a validation study

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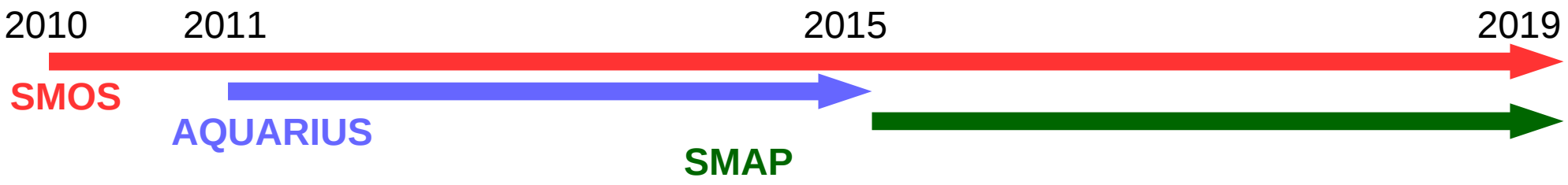
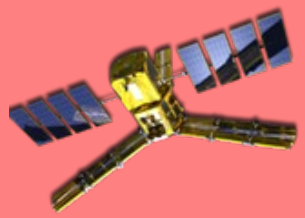
Sea-Ice Workshop – 4-5 June 2019 – Brest, France

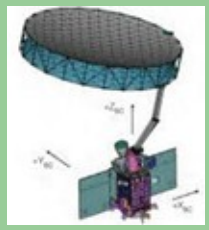
SSS L-band space measurements





SMOS MISSION (ESA)
Mission characteristics:
-L-band interferometry
-revisit times: **4 days**
-resolution about **45 km**
-pseudo-cycle : <18 days

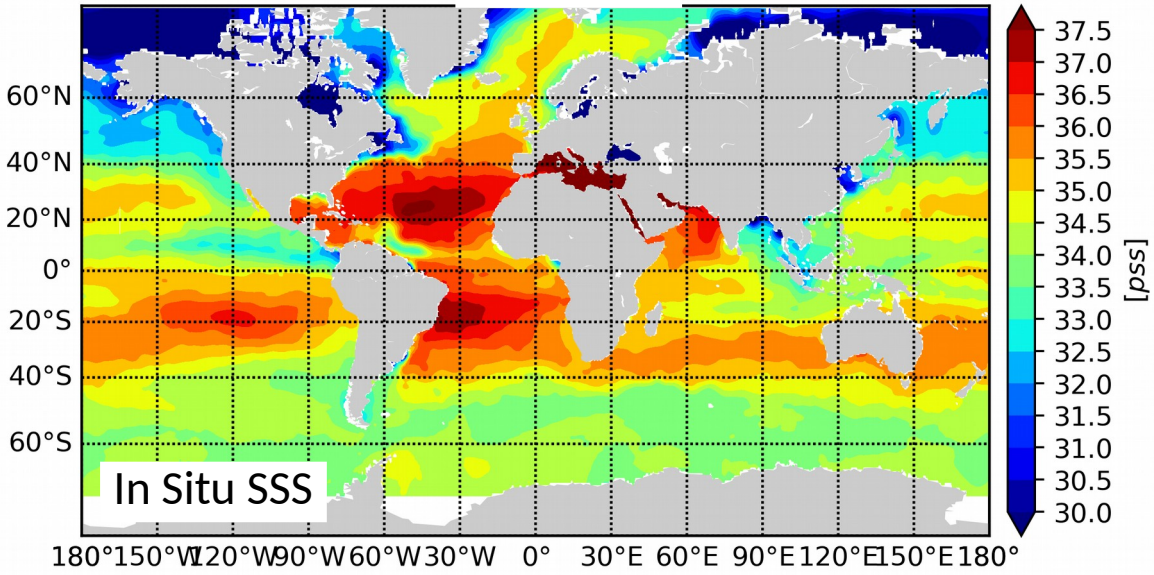
AQUARIUS MISSION (CONAE/NASA)
Mission characteristics:
-L-band real-aperture Radiometer, 3 beams
-revisit times: **7 days**
-resolution about **150 km**
-cycle : 8 days



SMAP MISSION (NASA)
Mission characteristics:
-L-band real-aperture radiometer
-revisit times: **3 days**
-resolution about **45 km**
-cycle : 8 days

SSS from space: a gap has been filled since 2010

August 2016



→ Resolving basin scale to mesoscale SSS

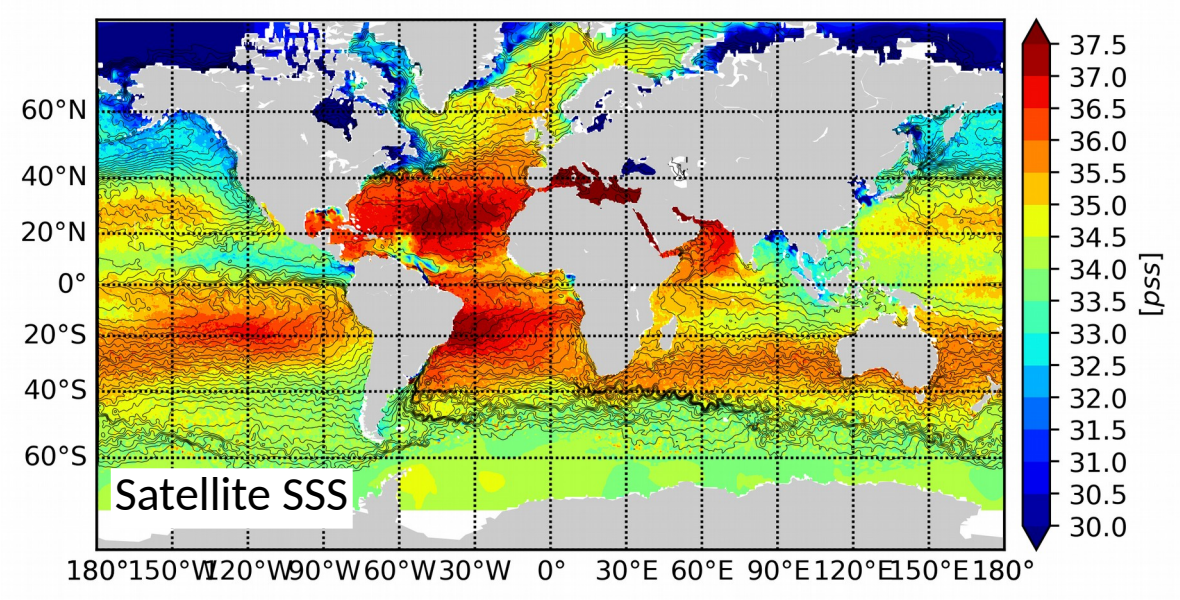
→ Freshwater plume and Water Cycle

→ Observing SSS climate signals (ENSO,...)

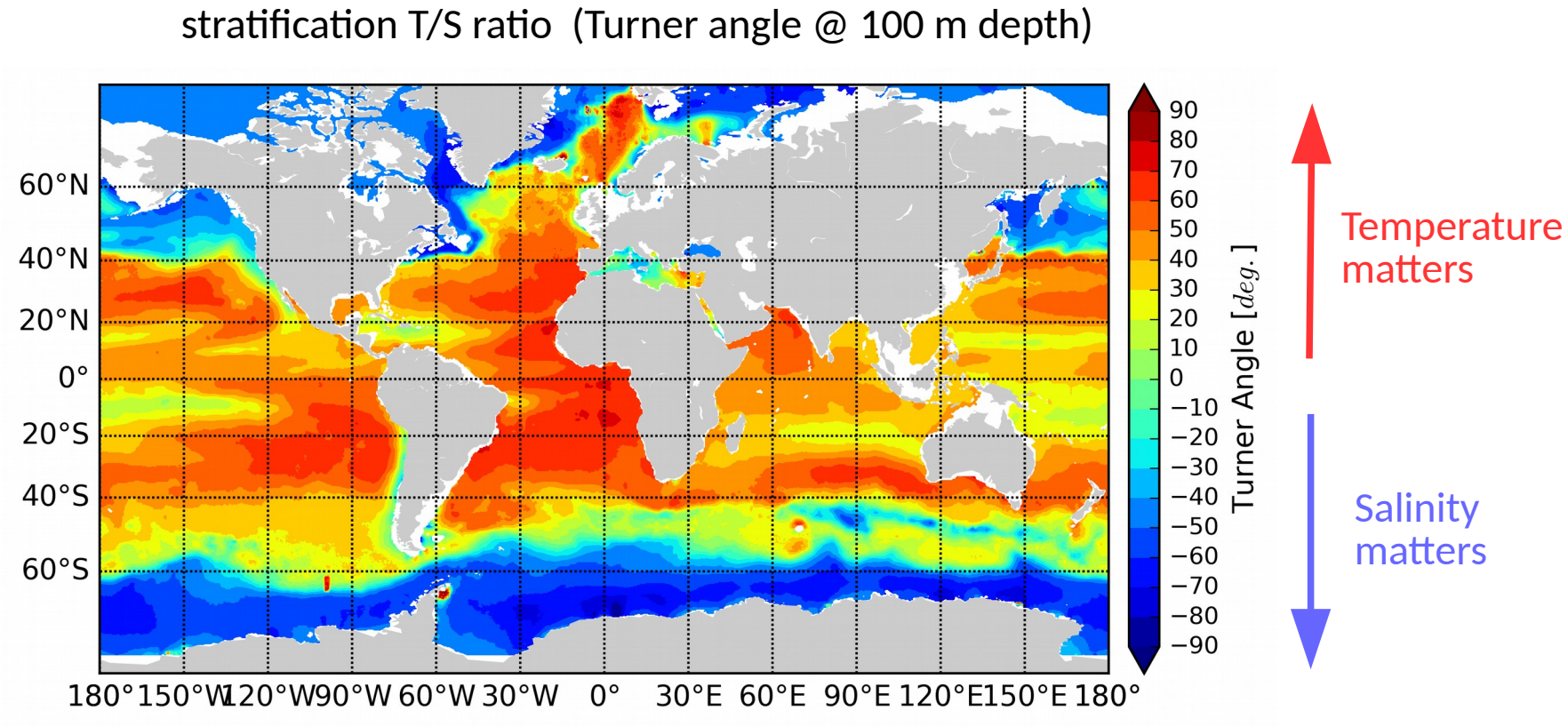
→ Upper ocean stratifiaction and air-sea interaction (Cyclone)

→ biogeochemistry

11 August 2016



Where does salinity matter?

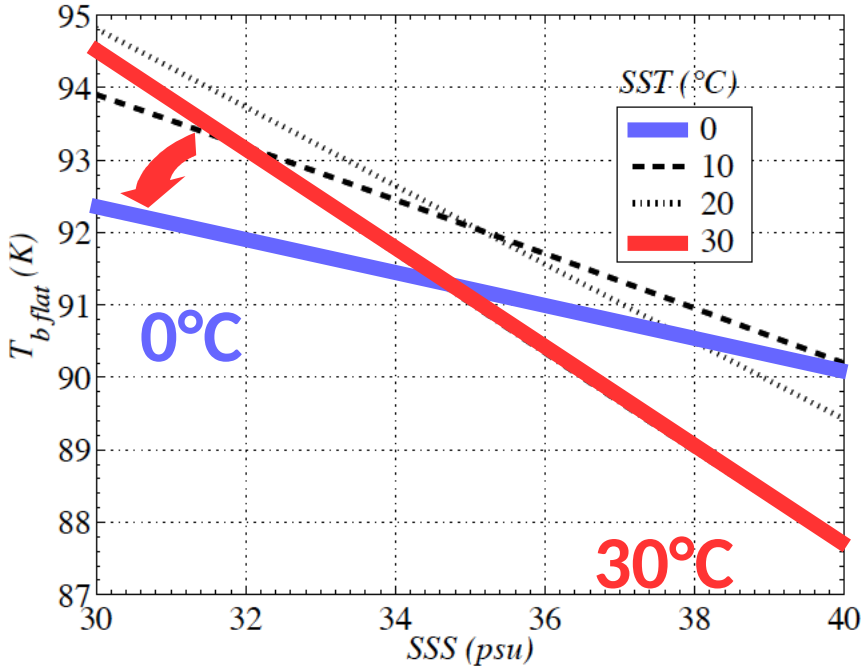


→ Salinity/Freshwater mainly matters at high latitude

→ **Can we observe salinity at high latitude from space ?**

L-Band SSS sensitivity at high latitude

Sensitivity of brightness T to SSS at a given temperature



→ L-Band radiometer SSS sensitivity reduced at low SST

→ Need to increase the signal/noise ratio

Outline

1. L-Band Data & Products
2. Validation of L-band at high latitudes
3. Case Studies
   → Polar front in Barents Sea
   → Freshwater plume in Laptev Sea (Anastasia's talk)

Data & Products

Satellite dataset (2015-2017)

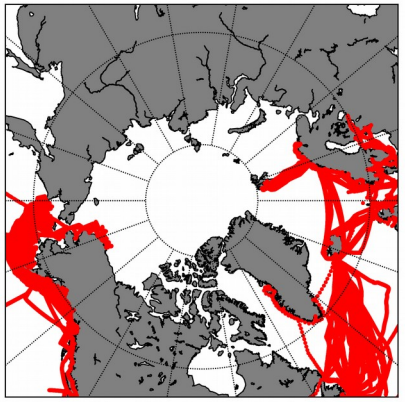
SMOS CEC L3 v3.0 (*Boutin et al.*, 2018)

SMAP RSS L3 v3.0 (*Meisner et al.*, 2018)

SMOS BEC L3 OA « Arctic »(L2 bias corr.,*Olmedo et al.*, 2018)

SMOS/SMAP L4 CEC OI (L3 bias corr., *Kolodziejczyk et al., in prep.*)

TSG data

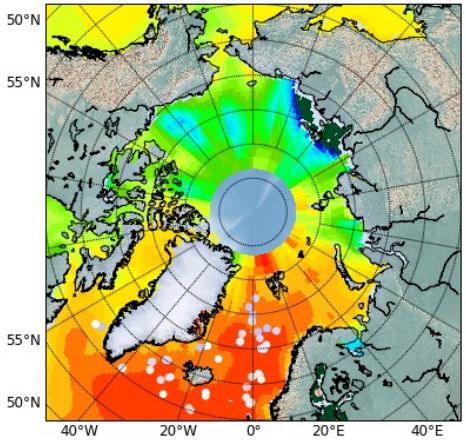


Validation dataset

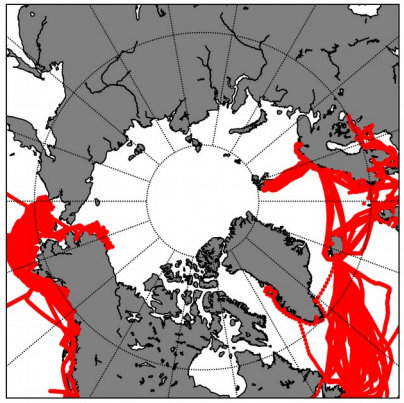
→ TSG data in high latitude (>50°N-S)

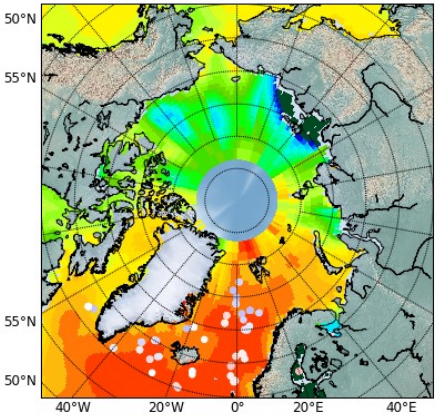
→ Argo

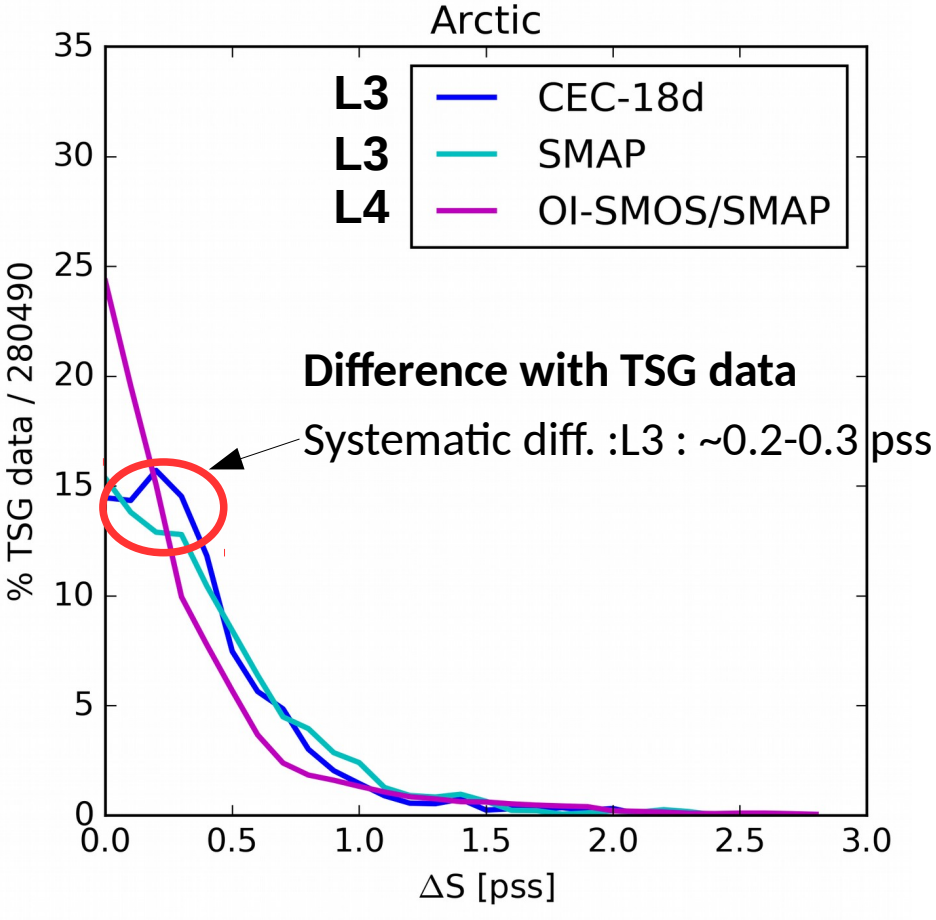
Argo data

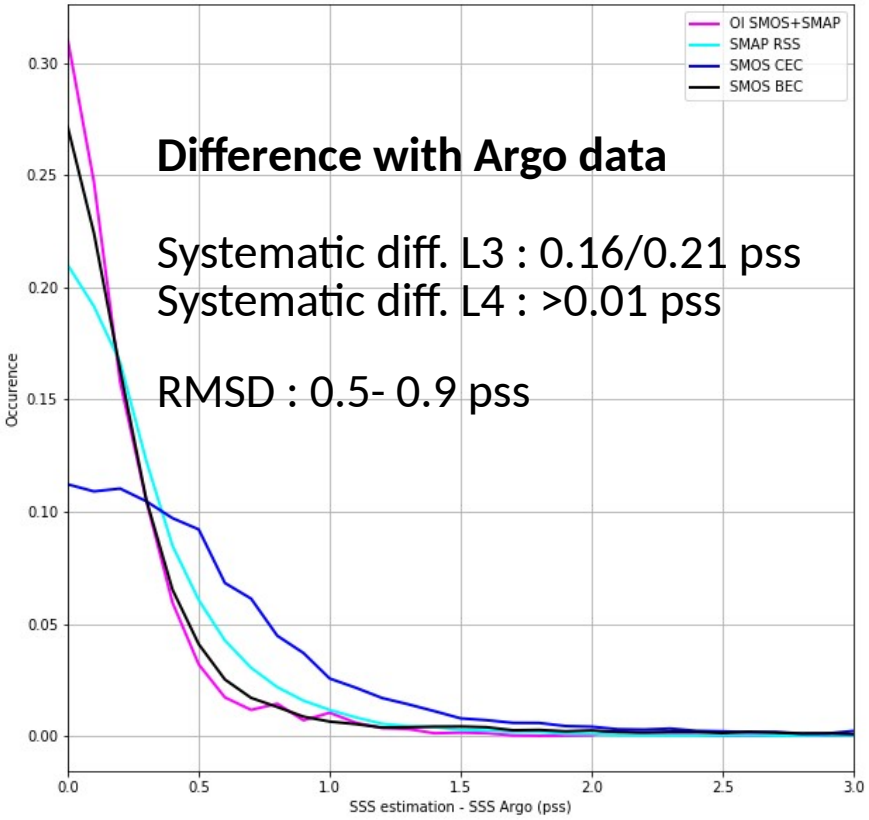


Validation : L3 & L4 SSS 2016-2017

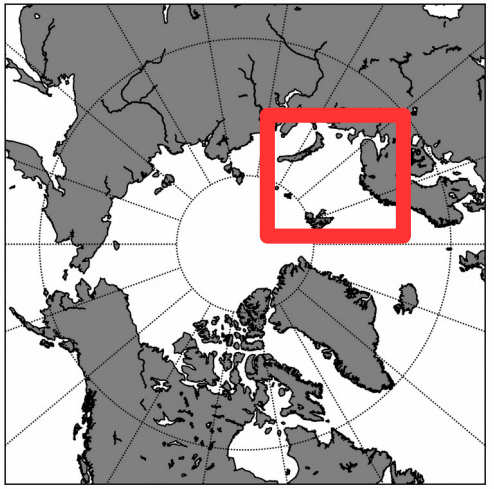








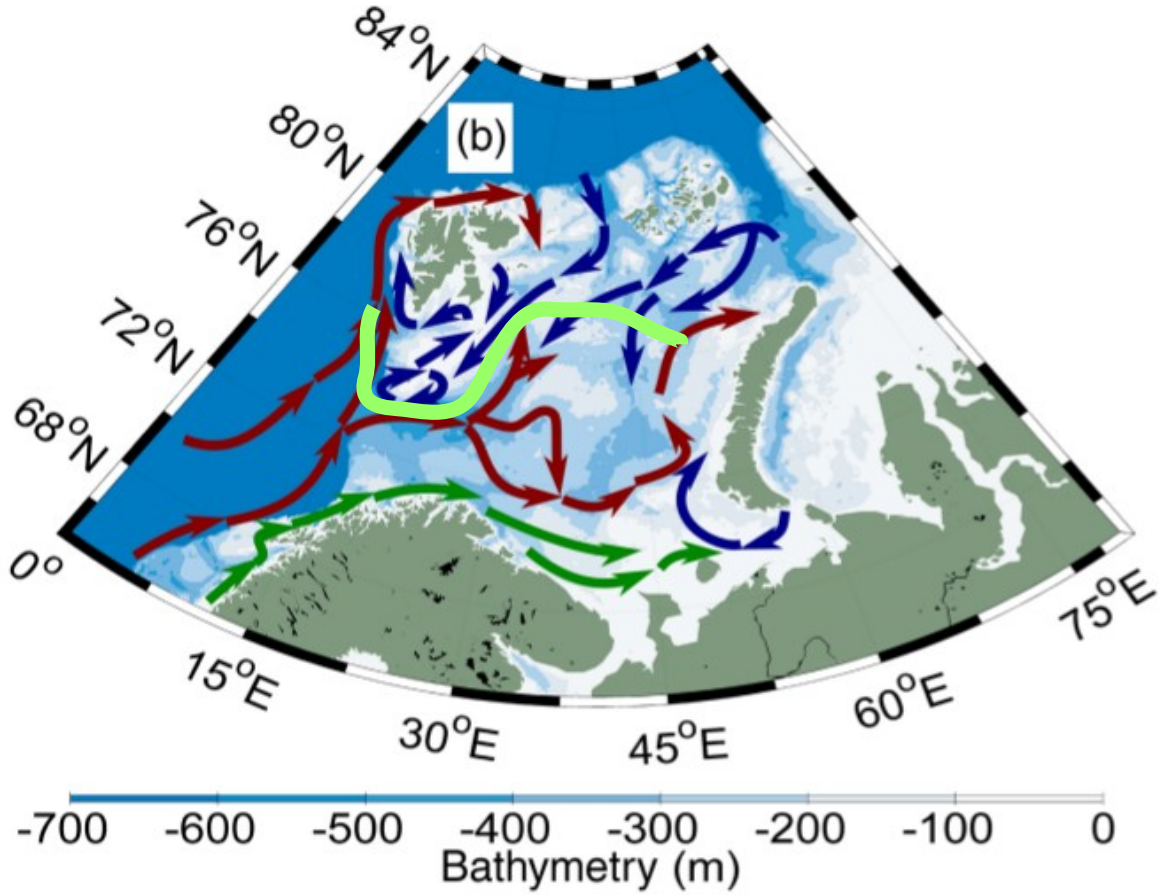
Case Study : Polar Front in Barents Sea



→ localisation of the polar front

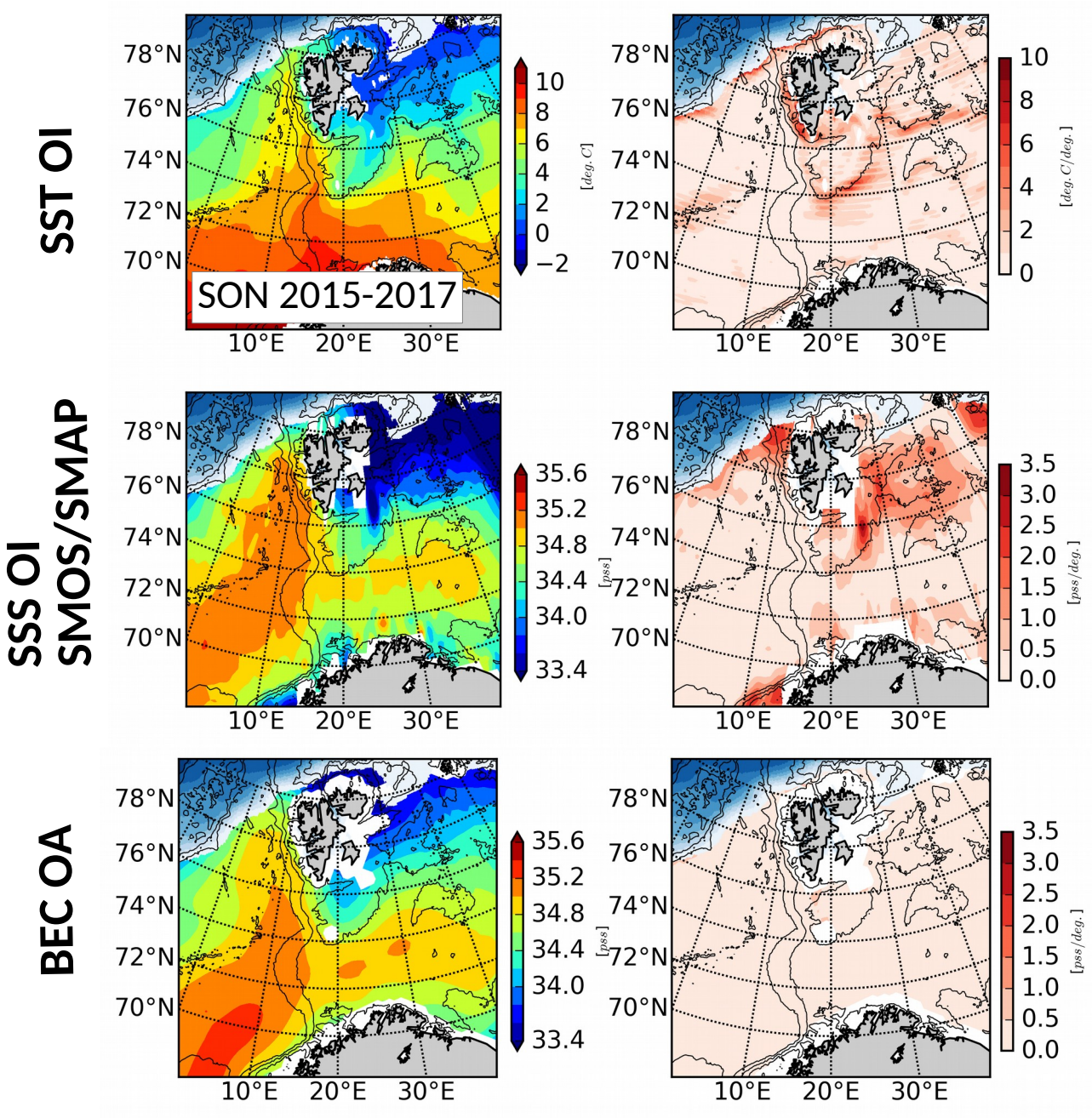
→ Warm/salty Atlantic waters vs Arctic Water

→ Generation of deep waters



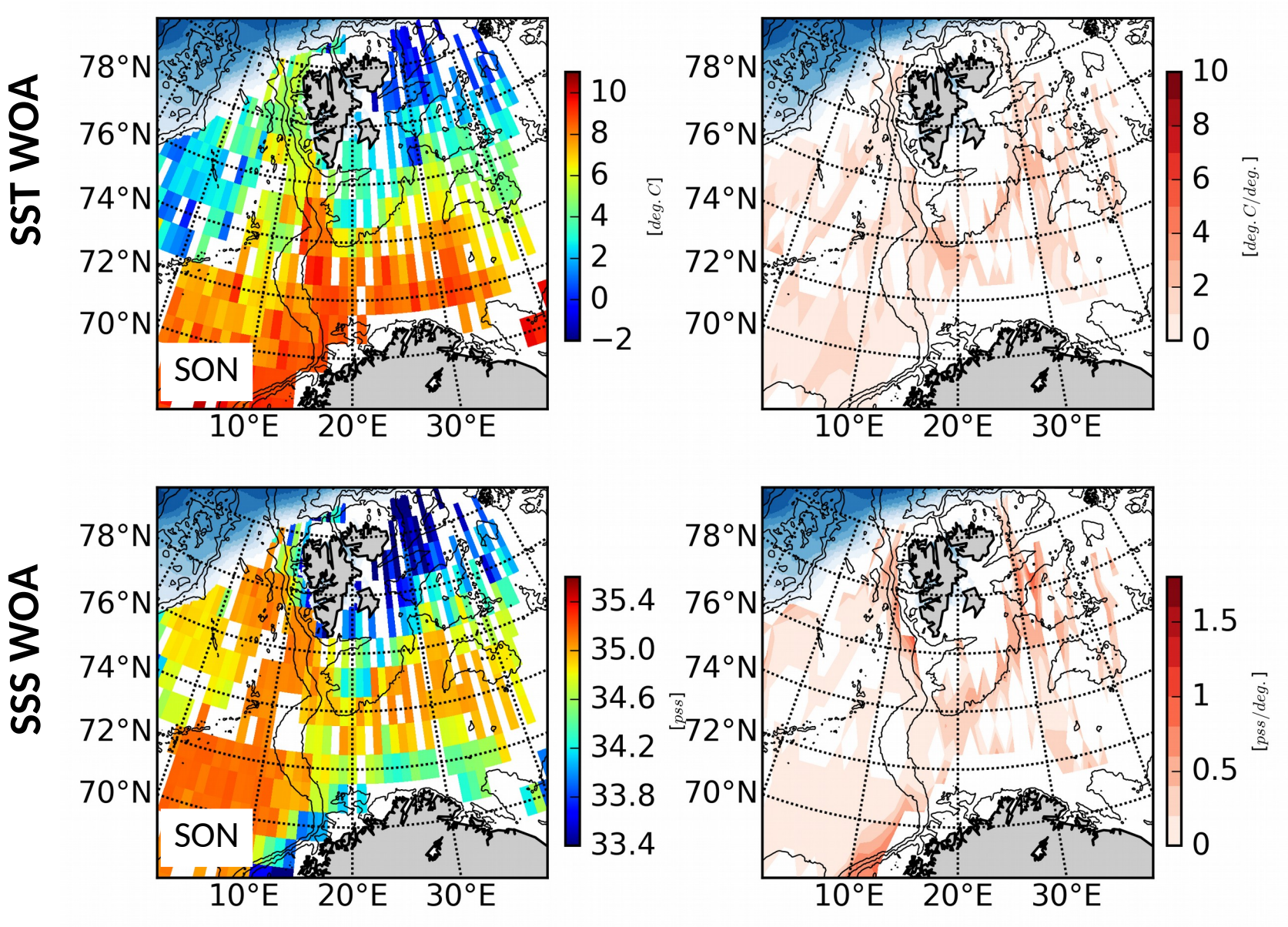
Oziel et al., (2016)

Case Study : Polar Front in Barents Sea



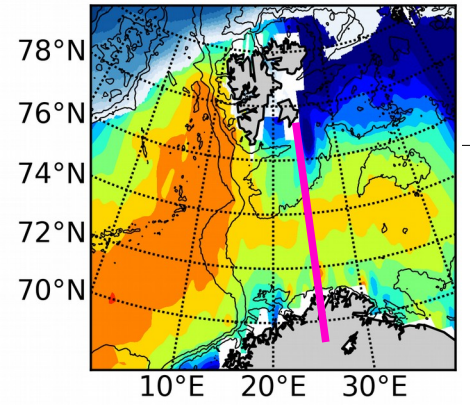
→ Barents Sea Polar front (*Barton et al.*, 2018)

Case Study : Polar Front in Barents Sea



→ WOA13 in situ data over 2000-2010

Case Study : Polar Front in Barents Sea

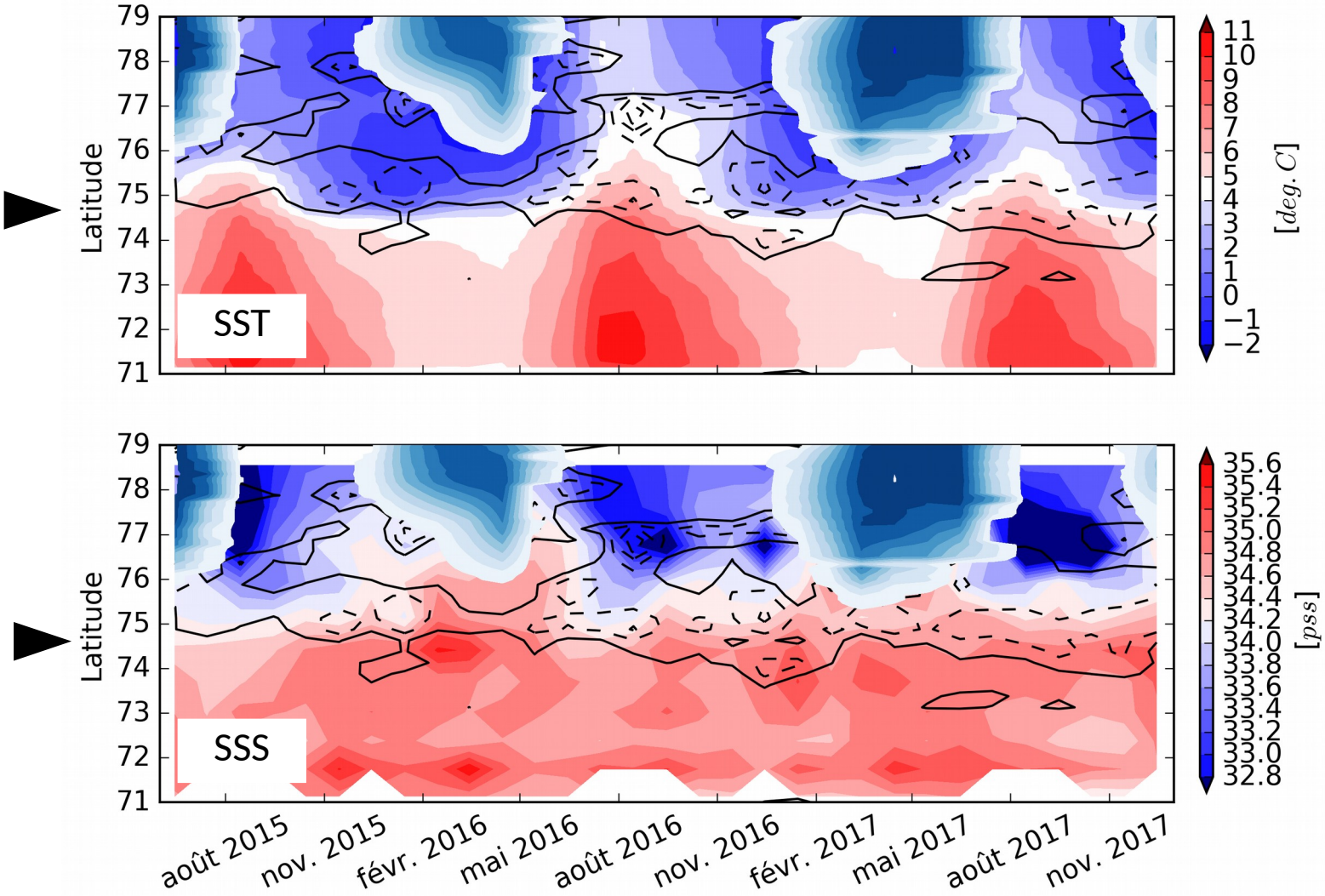


→ SST/SSS front

→ SSS & SST gradients along isobath ~250 m

→ drivers : freshwater flux, advection, heat flux ?

- 250 m isobath



- 250 m isobath

Black contours : along topography velocity

Conclusion

- L-Band satellite measurements provide reliable measurements of SSS contrasts at high latitudes
- L3 SMOS/SMAP products need bias corrections at high latitudes
- L4 SMOS/SMAP OI improves the absolute SSS estimates and spatial patterns at high latitudes
- Less in situ data at high latitudes for validation

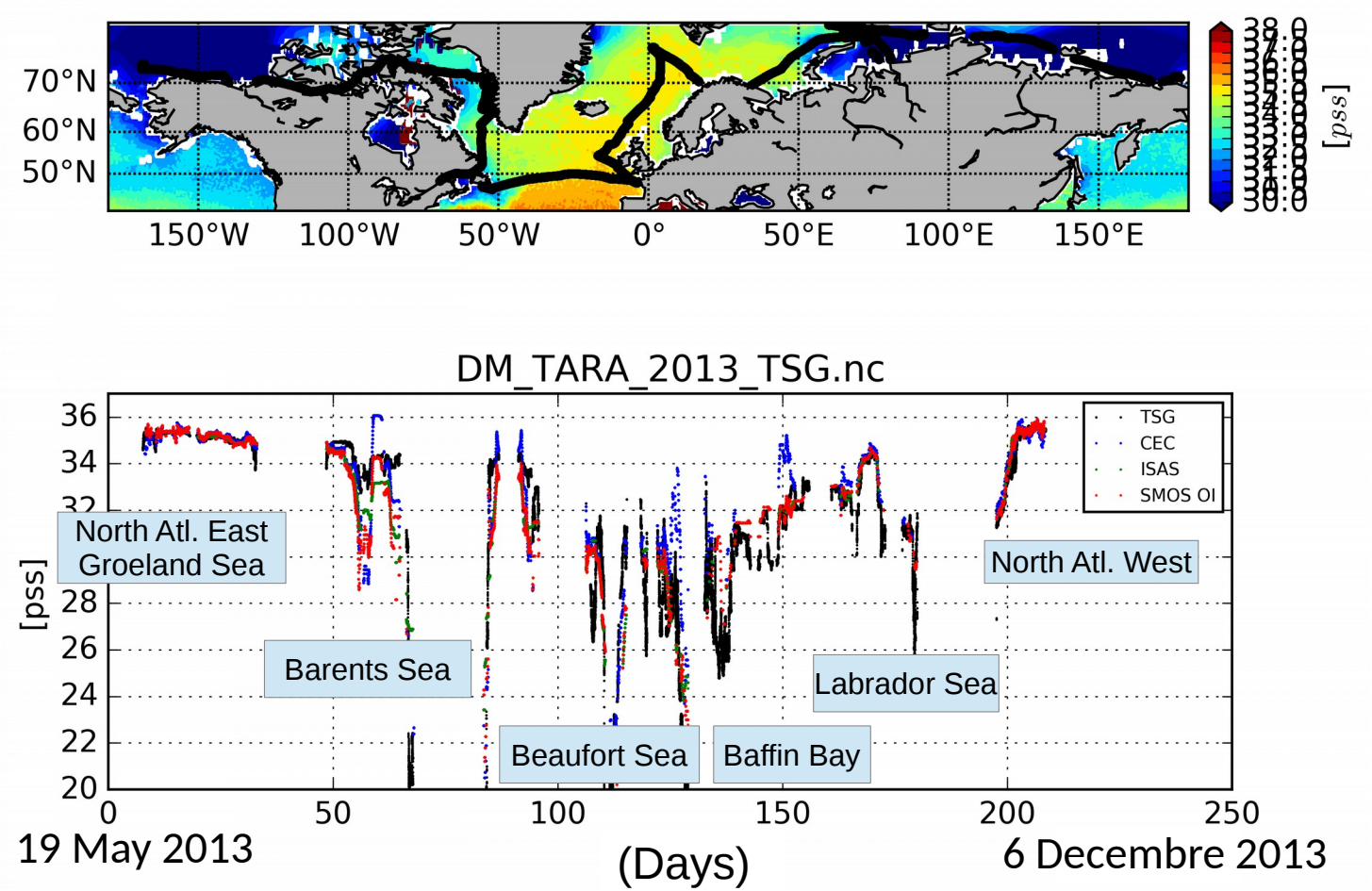
Case studies :

- Barents Sea : Topographic control of SSS/SST polar front
- Laptev Sea : Wind driven river plume variability

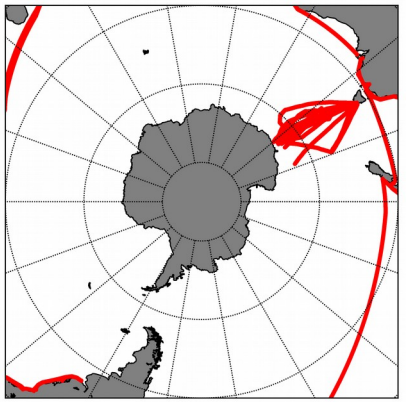
(→ Anastasia's talk)

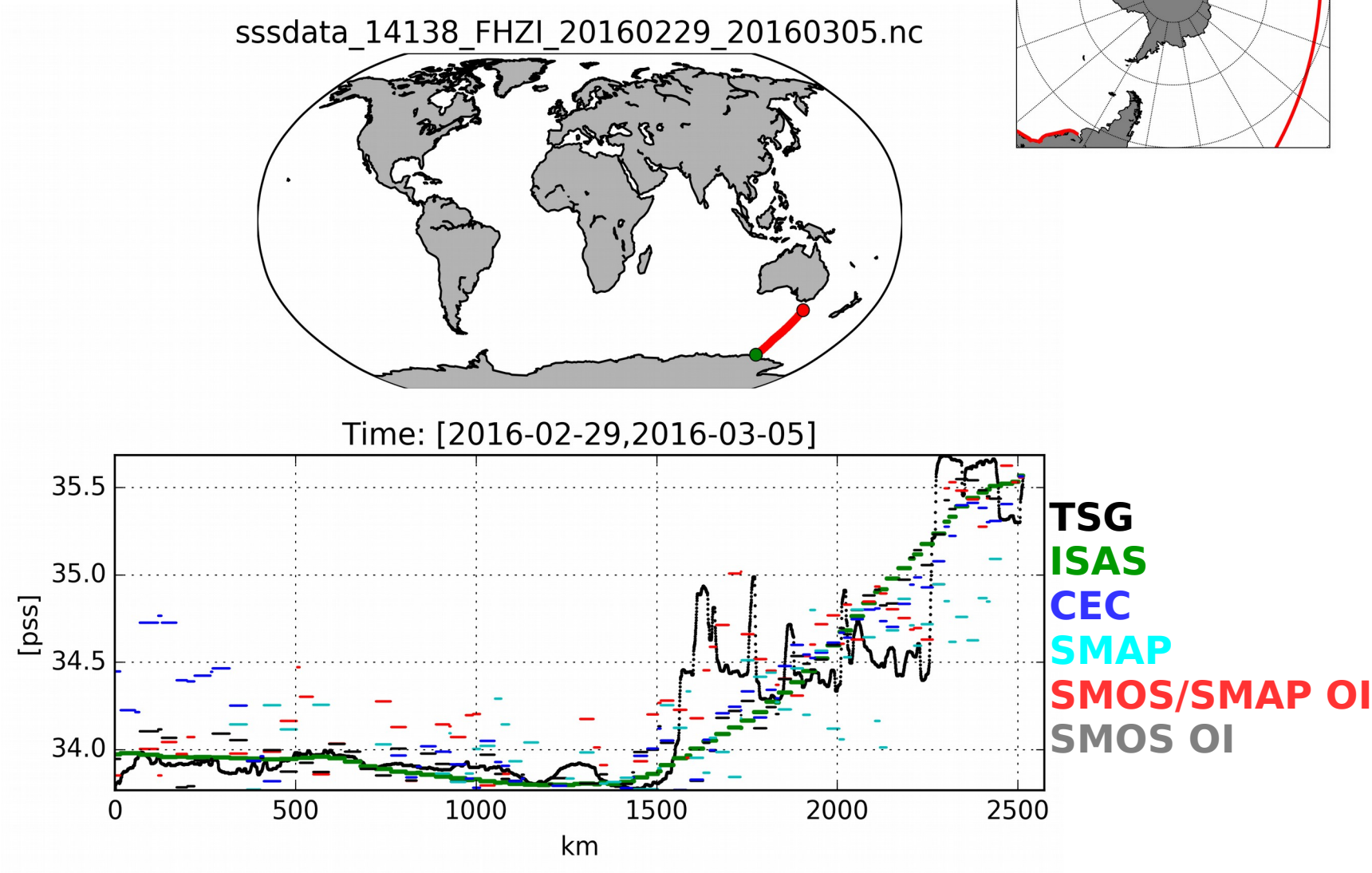
Extra Slides

Validation example: SMOS in Arctic (TARA)

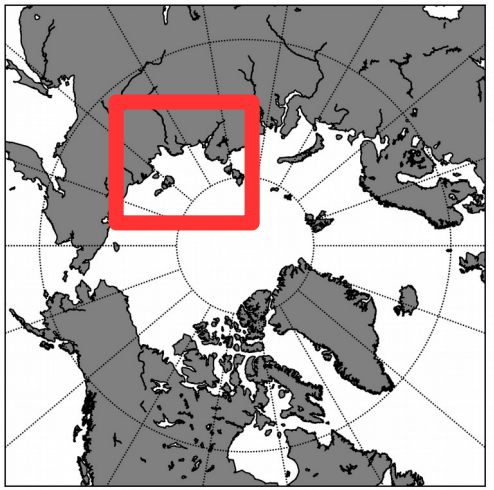


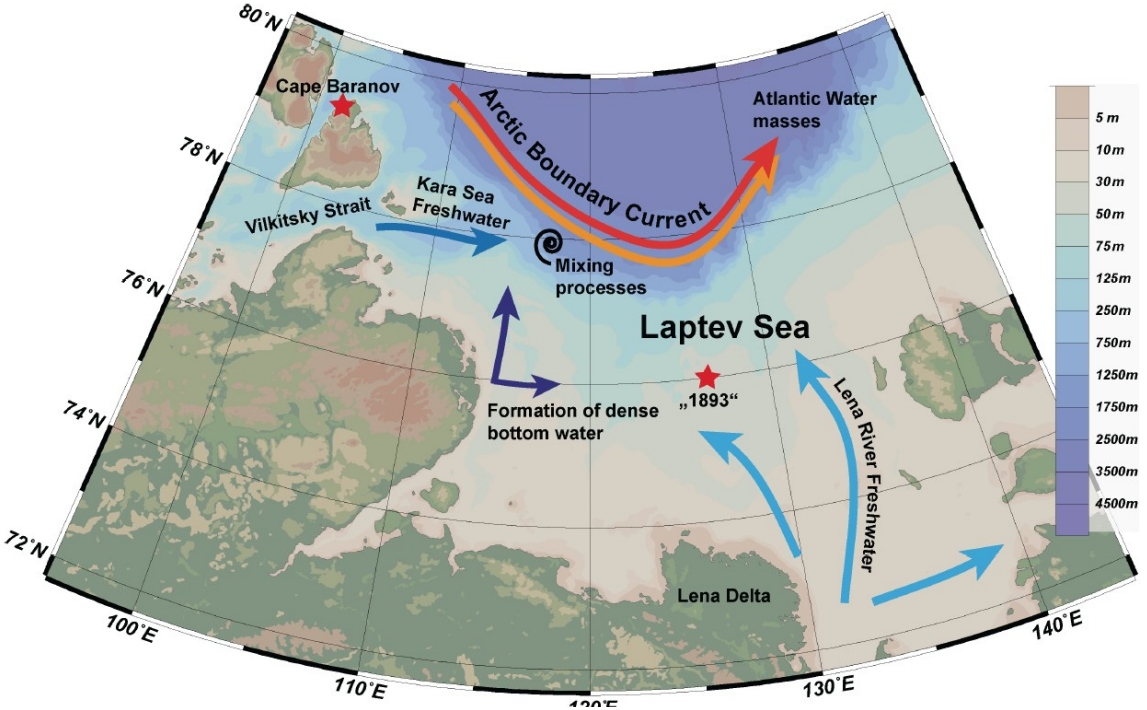
Validation example : SMOS/SMAP in Soutern Ocean

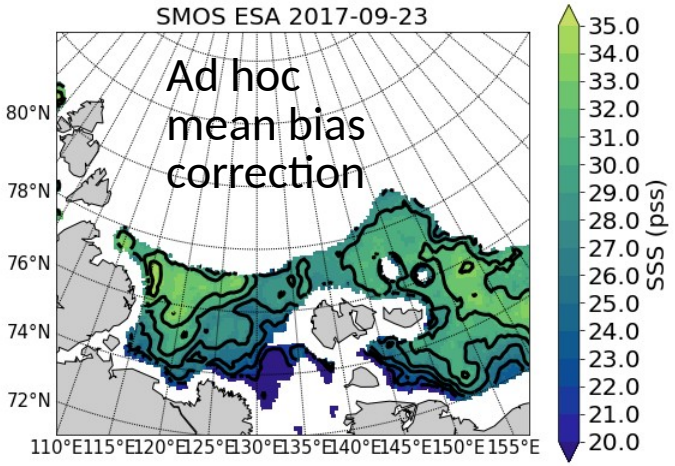


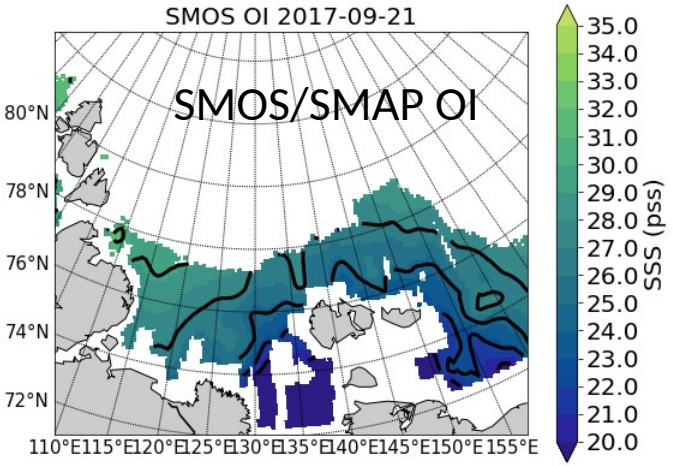


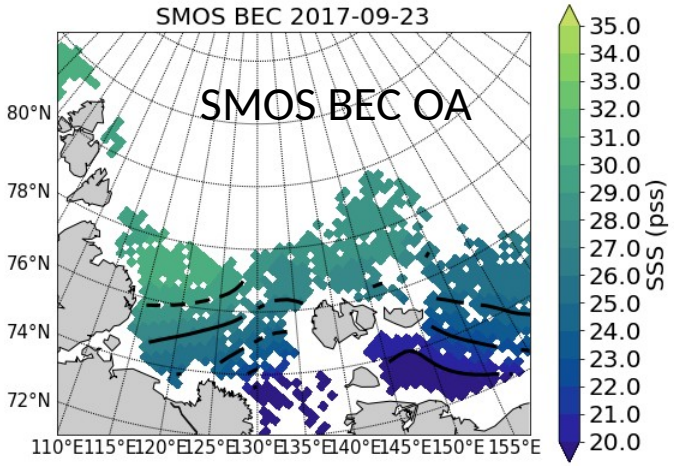
Case Study 1 : River plume in Laptev Sea





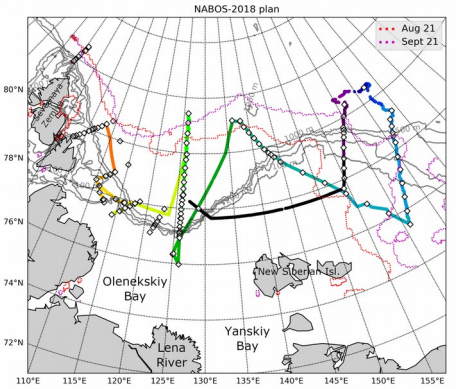


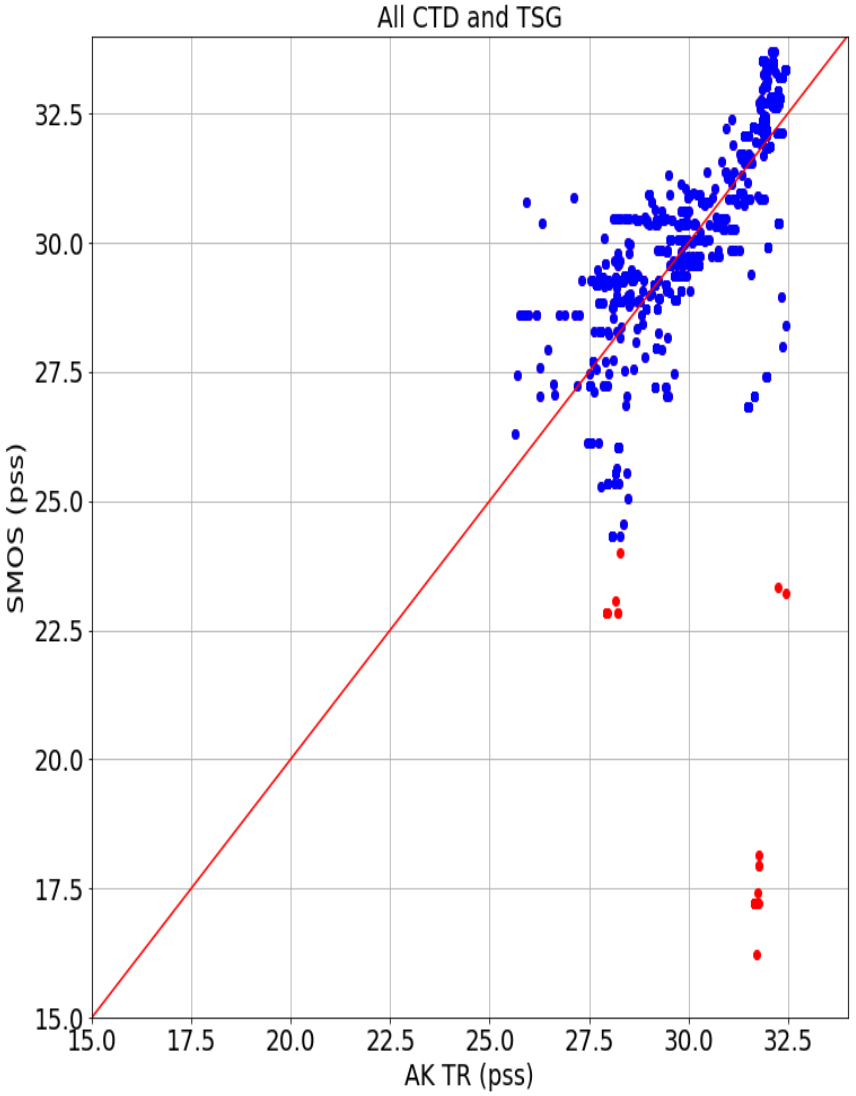




→ Wind driven Lena river plume extension (see Anastasia’s talk)

Case Study 1 : River plume in Laptev Sea

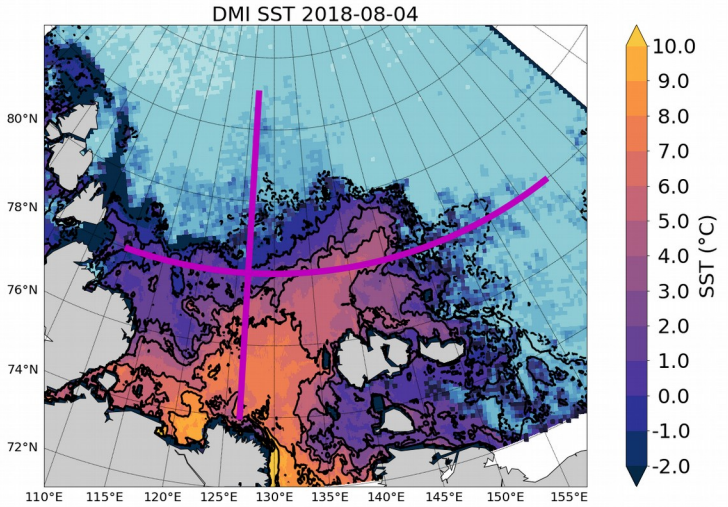


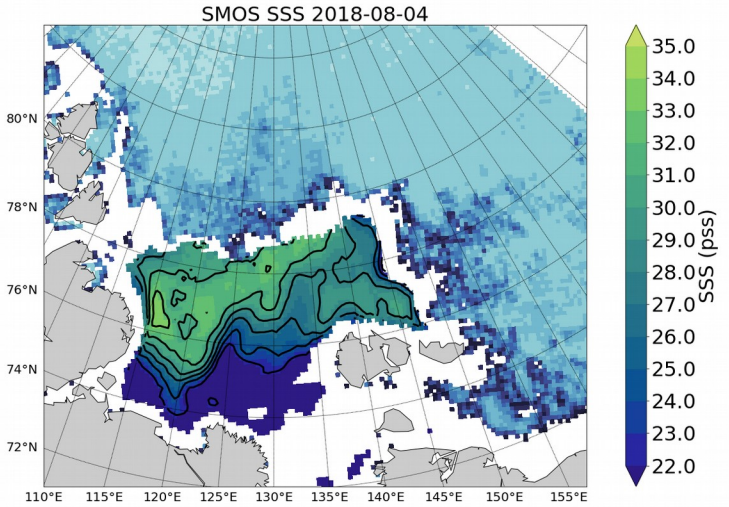


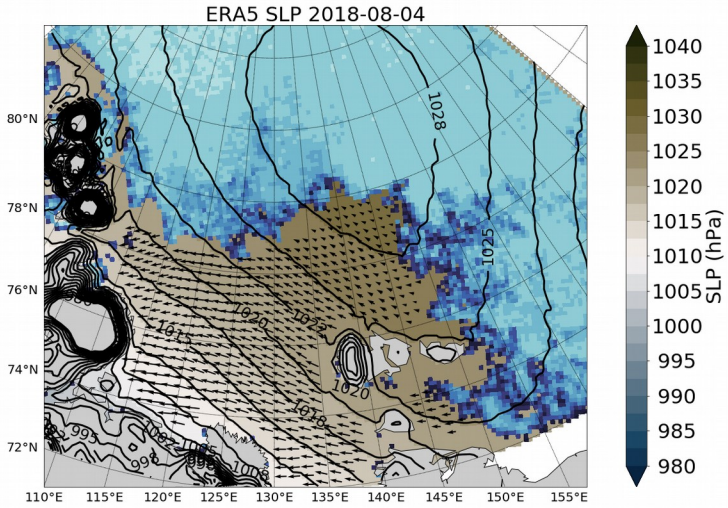
Scatterplot SMOS versus in-situ
after bias correction
(TSG Akademik Tryoshnikov, 2018)

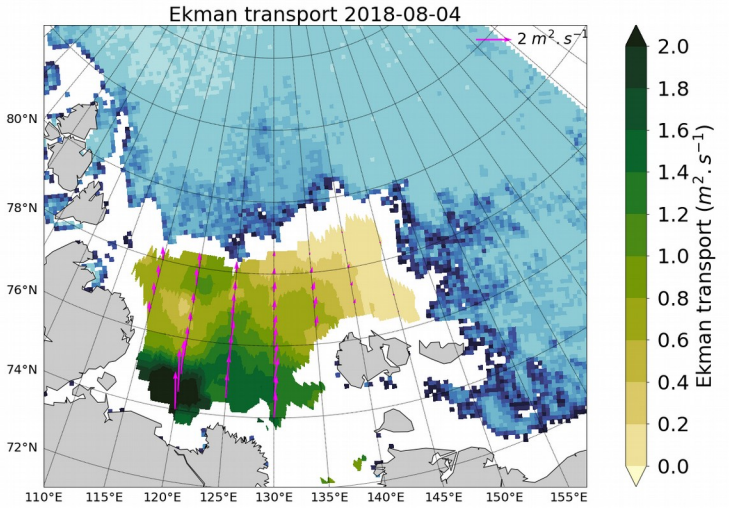
Depth	r	Bias to correct (pss)	SoD (pss)	N
All	0.76	-2.06	1.36	977

Case Study 1 : River plume in Laptev Sea





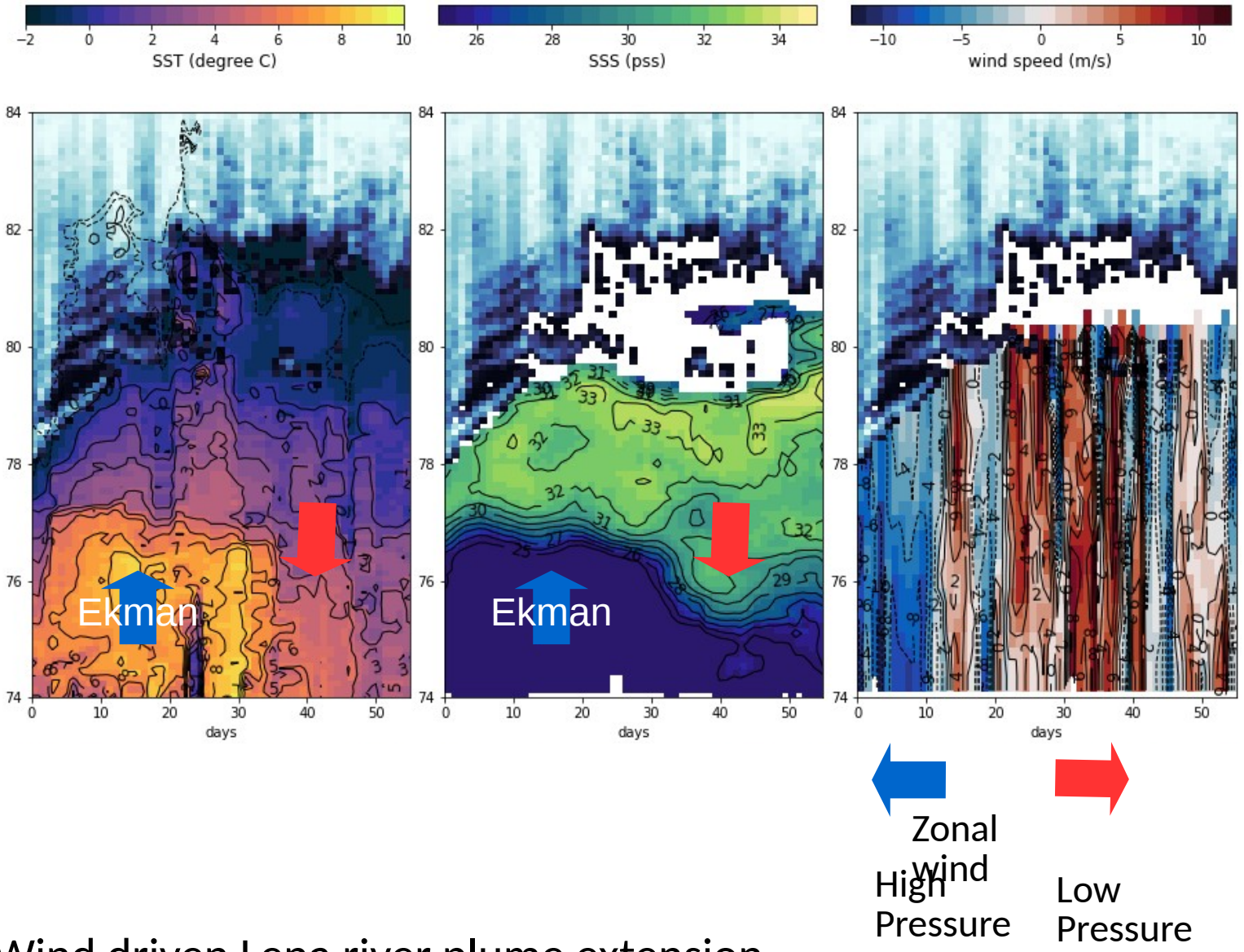




→ Wind driven Lena river plume extension (see Anastasia's talk)

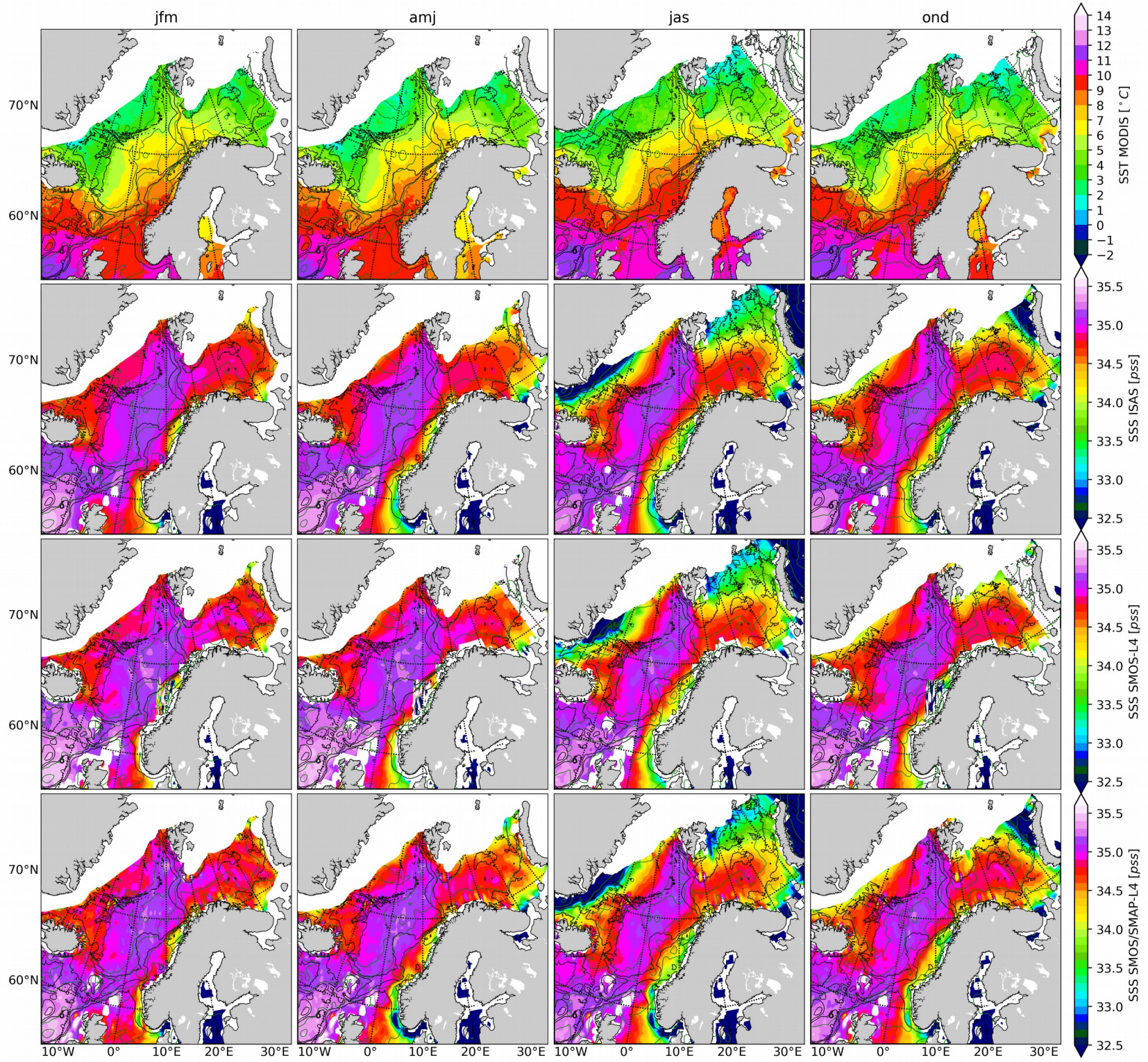
Tarasenko et al., 2019, submitted

Case Study 2 : River plume in Laptev Sea



→ Wind driven Lena river plume extension

Tarasenko et al., 2019, to be submitted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SST MODIS [°C]
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SSS SMOS-L4 [pss]
SSS SMOS/SMAP-L4 [pss]
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35.0
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32.5

Case Study : Polar Front in Barents Sea

→ Comparison ISAS/ L4 OI SMOS with/without SMAP